CLAIMS

What is claimed is:

1. A method comprising:

dynamically discovering an available lightpath route comprising a concatenation of a plurality of lightpath segments connected via respective nodes along a route spanning from a source edge node to a destination edge node and including at least one switching node in an optical switched network; and

reserving network resources to enable transmission of data between the source and destination nodes along the lightpath route during a scheduled time slot, wherein reservation of the network resources causes said at least one switching node and the source and destination edge nodes to be configured so as to form a virtual optical-switched circuit between the source and destination edge nodes during the scheduled time slot.

2. The method of claim 1, wherein the optical switched network comprises a photonic burst switched (PBS) network.

3. The method of claim 2, wherein the optical burst switched network comprises a wavelength-division multiplexed (WDM) PBS network.

4. The method of claim 1, wherein the lightpath route is dynamically discovered by performing operations including:

(a) generating a routing tree table at each of a plurality of switching nodes in the optical switched network;

(b) storing resource reservation data at each of the switching nodes;

(c) sending a lightpath reservation request identifying a time slot to be scheduled from the source edge node to a first next hop node comprising a first hop along the lightpath route;

(d) determining if the first next hop node has sufficient resources to support transmission of data via an optical-switched lightpath signal that is to be switched through the node during the time slot;

(e) determining a second next hop comprising one of a switching node or the destination edge node based on routes in the routing tree table in combination with the resource reservation data maintained at the first next hop node;

(f) forwarding the lightpath reservation request to the second next hop node; and

(g) repeating operations (d) – (f) until the lightpath reservation request has been forwarded to an *n*th next hop node comprising the destination node.

5. The method of claim 4, further comprising:

making a soft reservation for a node resource if sufficient resources to support the lightpath reservation are determined to be available for the time slot.

6. The method of claim 5, wherein soft reservations of the node resources are made during a upstream traversal of the lightpath route, and the method further comprises:

passing a resource reservation response message between the nodes in a downstream traversal of the lightpath route, the resource reservation response message including resource reservation response information;

extracting, at each node, the resource reservation response information from the resource reservation response message; and

changing, at each node, the soft reservation for the node resource to a hard reservation.

7. The method of claim 6, wherein the resource reservation response message comprises a *Resv* message having a format based on an extension to the RSVP-TE (ReSerVation Protocol – Traffic Engineering) signaling protocol.

8. The method of claim 4, wherein the lightpath reservation request includes a generalized multi-protocol label-switching (GMPLS)-based label defining transmission parameters for a lightpath segment to which the GMPLS-based label corresponds.

9. The method of claim 8, wherein the GMPLS-based label includes at least one field identifying an input wavelength employed for carrying signals over a lightpath segment identified by the GMPLS-based label.

10. The method of claim 4, wherein the lightpath reservation request comprises a *Path* message having a format based on an extension to the RSVP-TE (ReSerVation Protocol – Traffic Engineering) signaling protocol.

11. The method of claim 4, wherein the optical switched network comprises a photonic burst switched (PBS) network and wherein the lightpath reservation request is forwarded via a PBS control burst.

12. The method of claim 4, further comprising:

returning the lightpath reservation request along with an reservation error message to a previous node if it is determined at a current next hop node that the node does not have sufficient resources to support the lightpath reservation during the time slot;

determining a new next hop from the previous node based on routes in the routing tree table in combination with the resource reservation data maintained at the previous node; and

repeating operations (d) - (f) beginning at the new next hop until the lightpath reservation request has been forwarded to the destination node..

13. The method of claim 1, wherein a partial use of a node resource may be reserved.

14. The method of claim 13, wherein the partial use comprises a bandwidth percentage use of a lightpath segment.

15. A switching node apparatus for use in an optical switched network, comprising:

optical switch fabric, having at least one input fiber port and at least one output fiber port; and

a control unit, operatively coupled to control the optical switch fabric, including at least one processor and a first storage device operatively coupled to said at least one processor containing machine-executable instructions, which when executed by said at least one processor perform operations, including:

generating a routing tree table identifying applicable routes to route data between the switching node apparatus when implemented as a first node in an optical switched network and other nodes in the optical switched network;

maintaining a resource reservation table including reservations of switching node apparatus resources for scheduled time slots;

receiving a lightpath resource reservation request from a second node, said resource reservation request including data identifying an address of a destination node and a scheduled time slot for which resources for the switching node apparatus are requested to be reserved for a lightpath traversing a plurality of nodes from a source node to the destination node;

dynamically determining a third node comprising a next hop node for the lightpath based on routing information contained in the routing tree table and resource availability determined from the resource reservation table; and

forwarding the lightpath resource reservation request to the next hop node; and

reserving network resources corresponding to the lightpath resource reservation request to support routing of data through the switching node apparatus for the scheduled time slot.

16. The switching node apparatus of claim 15, wherein the network resource is reserved by performing operations including:

making a soft reservation of network resources supporting data transmission via the lightpath for the scheduled time slot;

receiving a reservation response; and

changing the soft reservation to a hard reservation to commit the network resources for the scheduled time slot.

17. The switching node apparatus of claim 16, wherein the resource reservation response message comprises a *Resv* message having a format based on an extension to the RSVP-TE (ReSerVation Protocol – Traffic Engineering) signaling protocol.

18. The switching node apparatus of claim 17, wherein execution of the instructions further performs the operation of storing resource reservation data on one of the first storage device or a second storage device operatively coupled to said at least one processor.

19. The switching node apparatus of claim 17, wherein the optical switched network comprises a photonic burst switched (PBS) network.

20. The switching node apparatus of claim 17, wherein the optical switched network comprises a wavelength-division multiplexed (WDM) PBS network; and the optical switching fabric provides switching of optical signals comprising different wavelengths carried over common fibers that may be respectively coupled to said at least one input fiber port and said at least one output fiber port.

21. The switching node apparatus of claim 17, wherein the lightpath resource reservation request message includes a generalized multi-protocol label-switching (GMPLS)-based label defining transmission parameters for the resource reservation.

22. The switching node apparatus of claim 21, wherein the lightpath resource reservation request message comprises a *Path* message having a format based on an extension to the RSVP-TE (ReSerVation Protocol – Traffic Engineering) signaling protocol.

23. The switching node apparatus of claim 22, wherein execution of the instructions further performs the operations of:

updating the *Path* message to include a GMPLS-based label corresponding to a resource reservation to be made for the next hop node.

24. The switching node apparatus of claim 15, wherein execution of the instructions further performs the operations of:

determining that insufficient resources are available at the next hop nodes of all applicable routes to the destination node; and

returning the lightpath resource reservation request to the first node along with error indicia informing the first node to select a new route to the destination node that does not pass through the switching node apparatus.

25. The switching node apparatus of claim 15, wherein said at least one processor includes a network processor.

26. The switching node apparatus of claim 15, wherein said at least one processor further includes a control processor.

27. A machine-readable medium to provide instructions, which when executed by a processor in a switching node apparatus comprising a first node in an optical switched network, cause the switching node apparatus to perform operations comprising:

generating a routing tree table identifying applicable routes to route data between the switching node apparatus when implemented as a first node in an optical switched network and other nodes in the optical switched network;

maintaining a resource reservation table including reservations of switching node apparatus resources for scheduled time slots;

receiving a lightpath resource reservation request from a second node, said resource reservation request including data identifying an address of a destination node and a scheduled time slot for which resources for the switching node apparatus are requested to be reserved for a lightpath traversing a plurality of nodes from a source node to the destination node;

dynamically determining a third node comprising a next hop node for the lightpath based on routing information contained in the routing tree table and resource availability determined from the resource reservation table; and

forwarding the lightpath resource reservation request to the next hop node; and

reserving network resources corresponding to the lightpath resource reservation request to support routing of data through the switching node apparatus for the scheduled time slot.

28. The machine-readable medium of claim 27, wherein the network resource is reserved by performing operations including:

making a soft reservation of network resources supporting data transmission via the lightpath for the scheduled time slot;

receiving a reservation response; and

changing the soft reservation to a hard reservation to commit the network resources for the scheduled time slot.

29. The machine-readable medium of claim 27, wherein execution of the instructions determines the next hop node by performing operations including:

(a) selecting a route from the switching apparatus to the destination node;

(b) determining if sufficient network resources are available to transmit data between the switching node apparatus an a first hop node in the route that is selected during the scheduled time slot;

(c) selecting the first hop node as the next hop node if sufficient network resources are available; otherwise

(d) selecting a new route from the switching apparatus to the destination node; and

repeating operations (b) – (d) until it is determined that a first hop node has sufficient network resources available.